



Performance Assessment and Space Qualification of 808 nm Quasi-constant Wave Laser Diode Arrays

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OUTLINE



- Motivation
- Research goals and strategy
- Progress on characterization capability
- Future plans
- Conclusions



Motivation



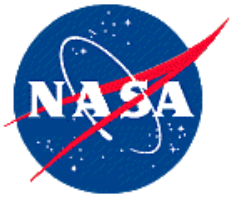
- Recent laser missions (GLAS, MOLA) and upcoming missions (MLA, CALIPSO, DLA, etc.) employ Q-switched Nd:YAG lasers
- Efficient pumping of these lasers requires quasi-CW Laser Diode Arrays (LDA) emitting at 808 nm
- Need information on performance and reliability of these devices under space flight conditions.



Research Goals



- ➔ *Quantify effect of operational and environmental parameters*
- ➔ *List of practices for handling, storage and operation*
- ➔ *Predictive/screening capability*
- ➔ *Improve reliability*
- ➔ *Lessons learned for purchasing procedure*



Environmental and Operational Parameters



Environment

- ➔ *Radiation*
- ➔ *Vacuum*
- ➔ *Vibration*
- ➔ *Cleanliness*
- ➔ *Aging*

Operation

- ➔ *Optical Power*
- ➔ Electrical drive pulse width, shape, frequency, amplitude
- ➔ *Temperature*
- ➔ *Power cycling*



Research Strategy



- Characterize LDAs - establish an initial baseline for individual array performance and status.
- Subject LDA to a form of stress - environment and/or life test
 - Radiation
 - Vacuum
 - Life test
- Characterize LDA again - quantify effect of the stressor
- Track changes and correlate to initial characterization or stressor

It is critical that our characterization be repeatable so changes we observe can be credited to stress parameter and not test error.



Environmental Monitoring Capabilities



ARTI HHPC-6 Particle Counter

- 0.3, 0.5, 0.7, 1.0, 2.0, 5.0 micron particles
- Humidity and Temperature



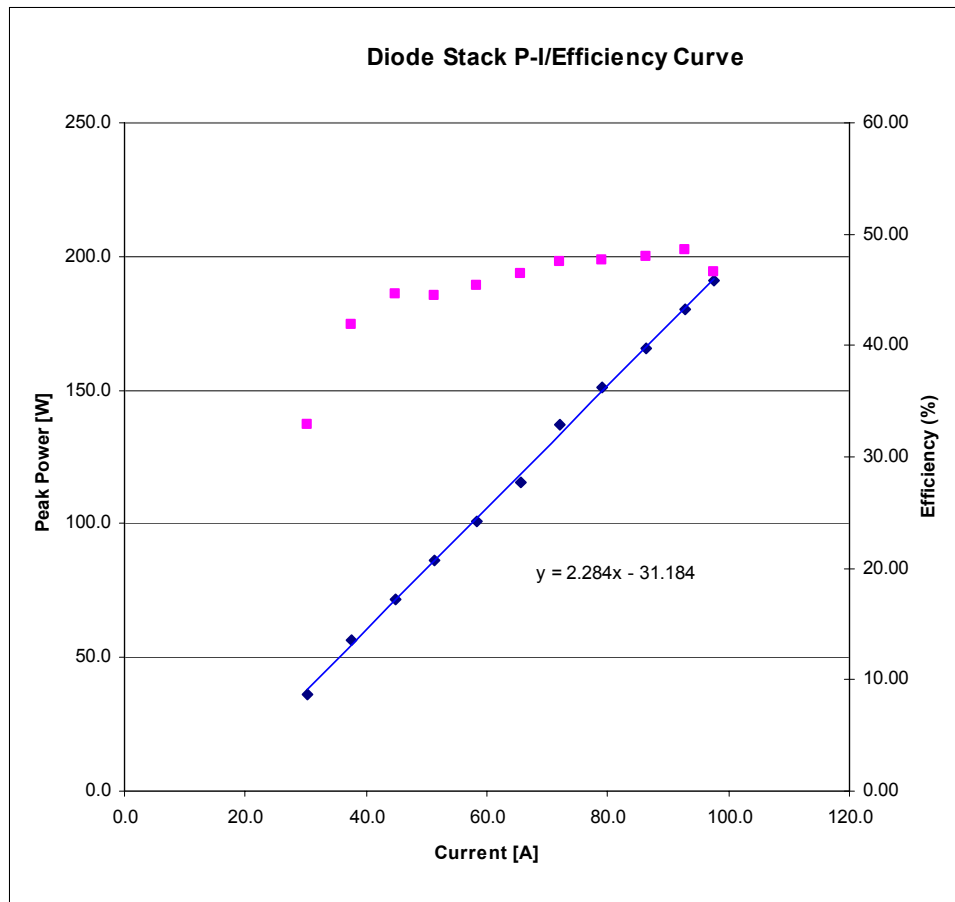
Electrical Characterization



- Current (pulse width, amplitude, frequency, duty cycle)
- Voltage (pulse width, amplitude, frequency, duty cycle)
- Resistance
- Efficiency
- Lasing threshold



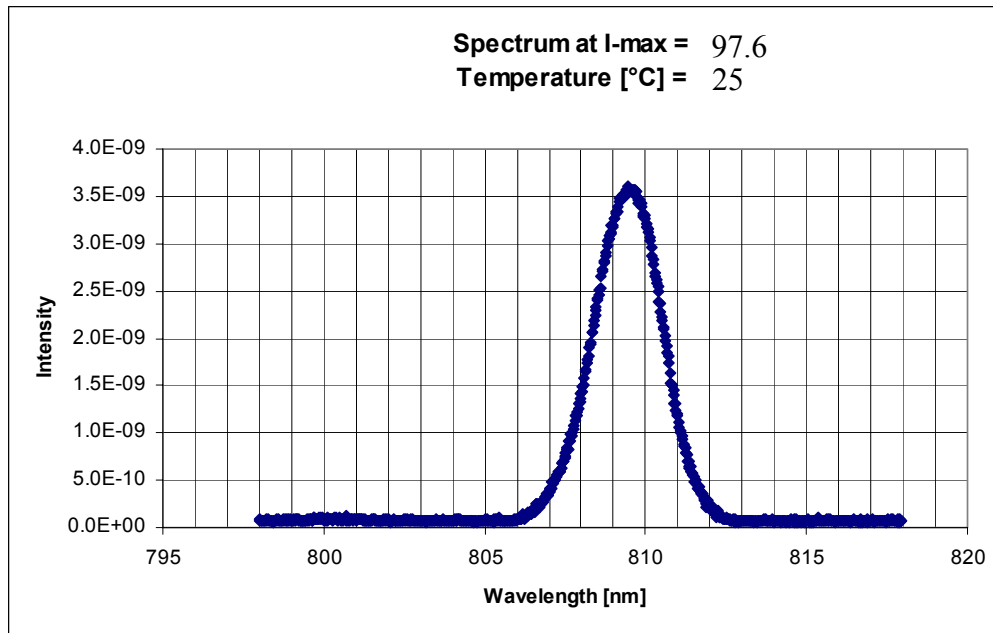
LDA Optical Power



- - Efficiency
- ◆ - Optical Power vs. Current



LDA Optical Spectrum



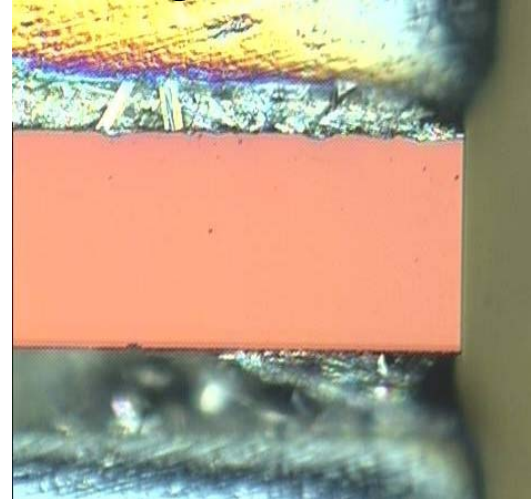
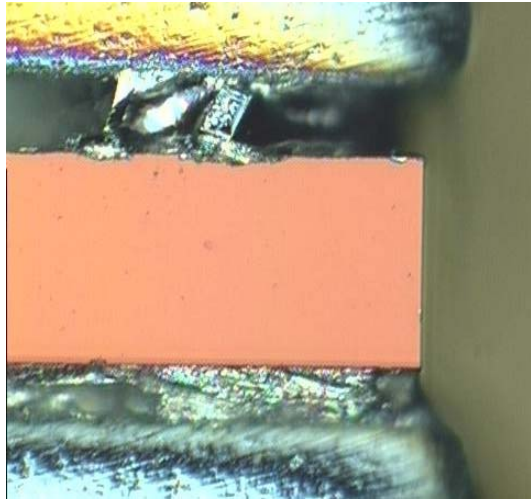
- Center wavelength – 809.48 nm
- Width – 2.33 nm



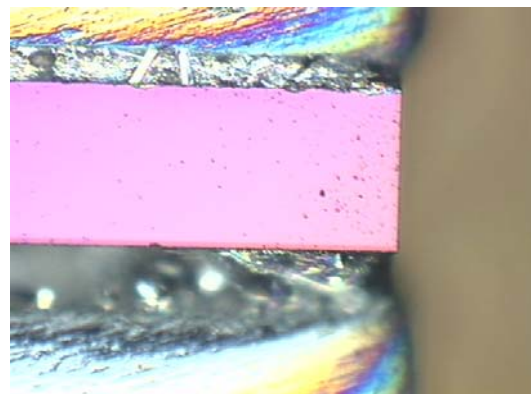
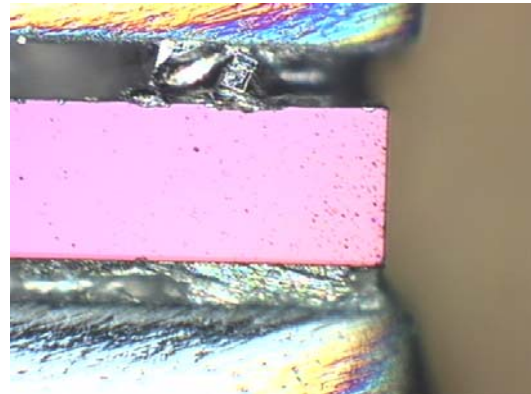
Microscope Inspection



Initial 200x Diode Bar Images

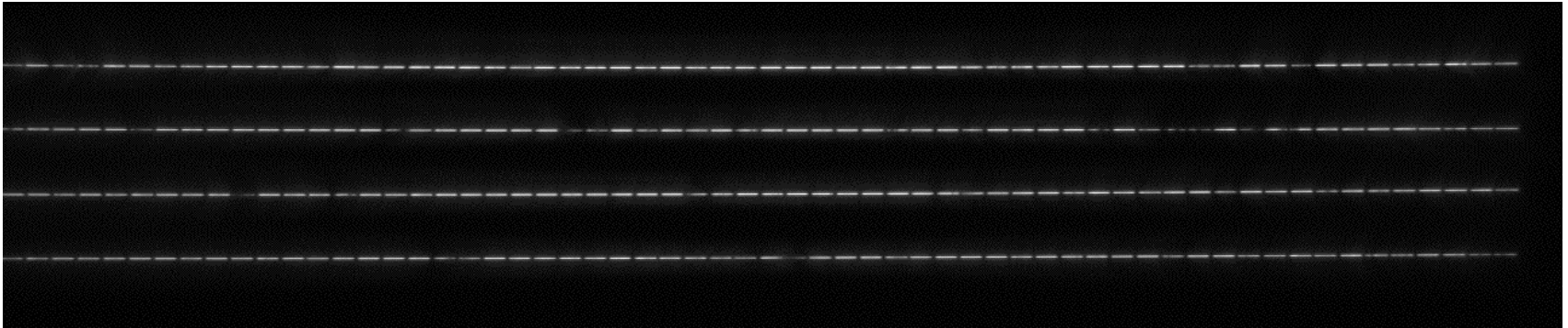


Images after Indium contamination

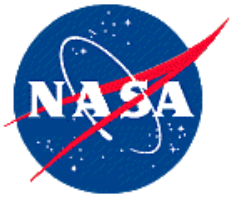




LDA Near Field Profile



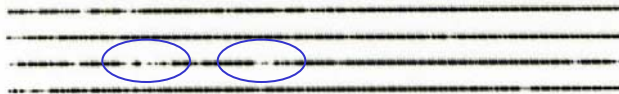
Near field image of 4-bar LDA showing optical power distribution across facet operating at full power. One megapixel monochrome 10bit digital CCD camera



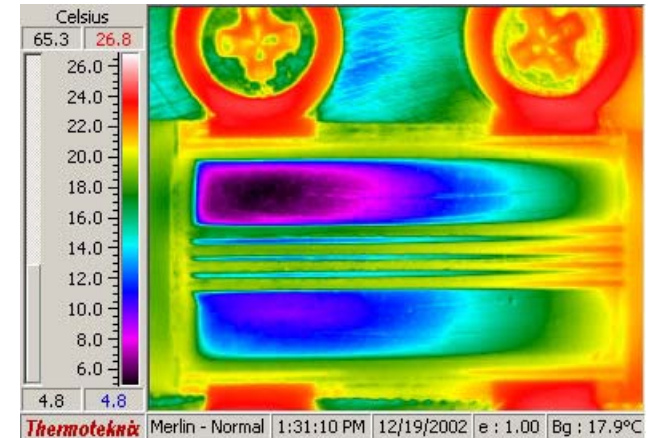
Infrared Inspection



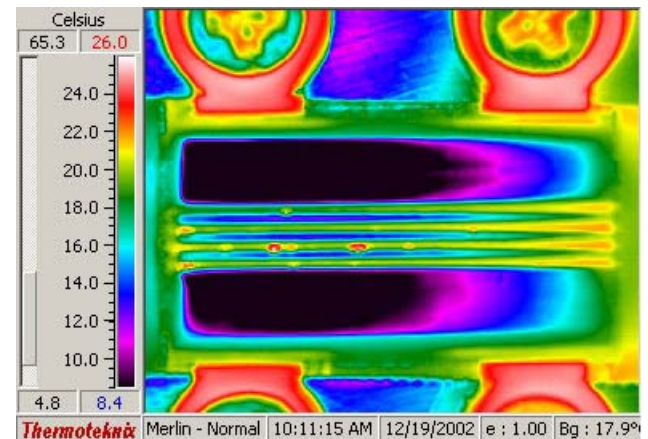
Near field image



Diode is off

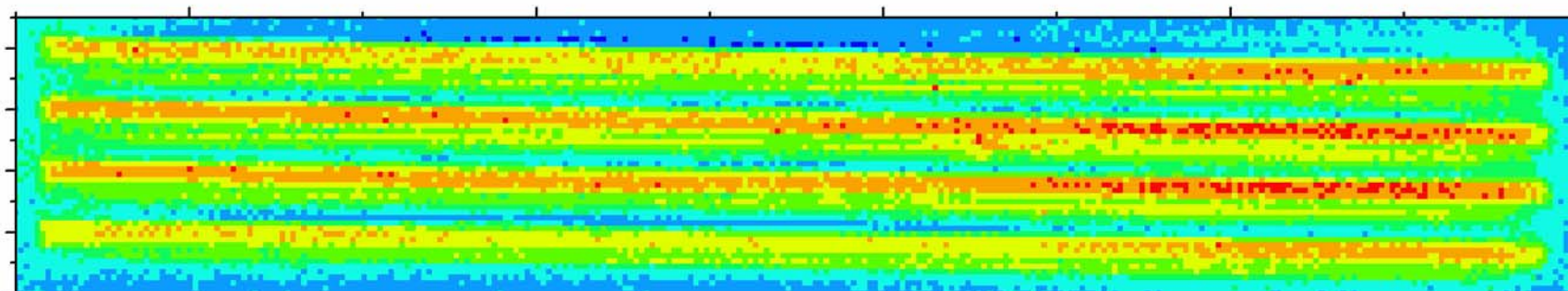


Diode is on

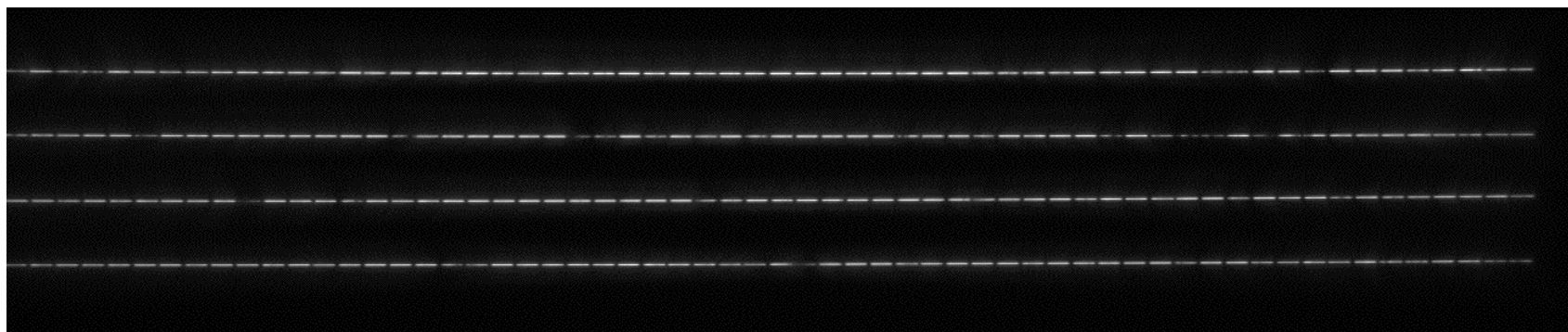




Comparison of Temperature profile and Near field emission



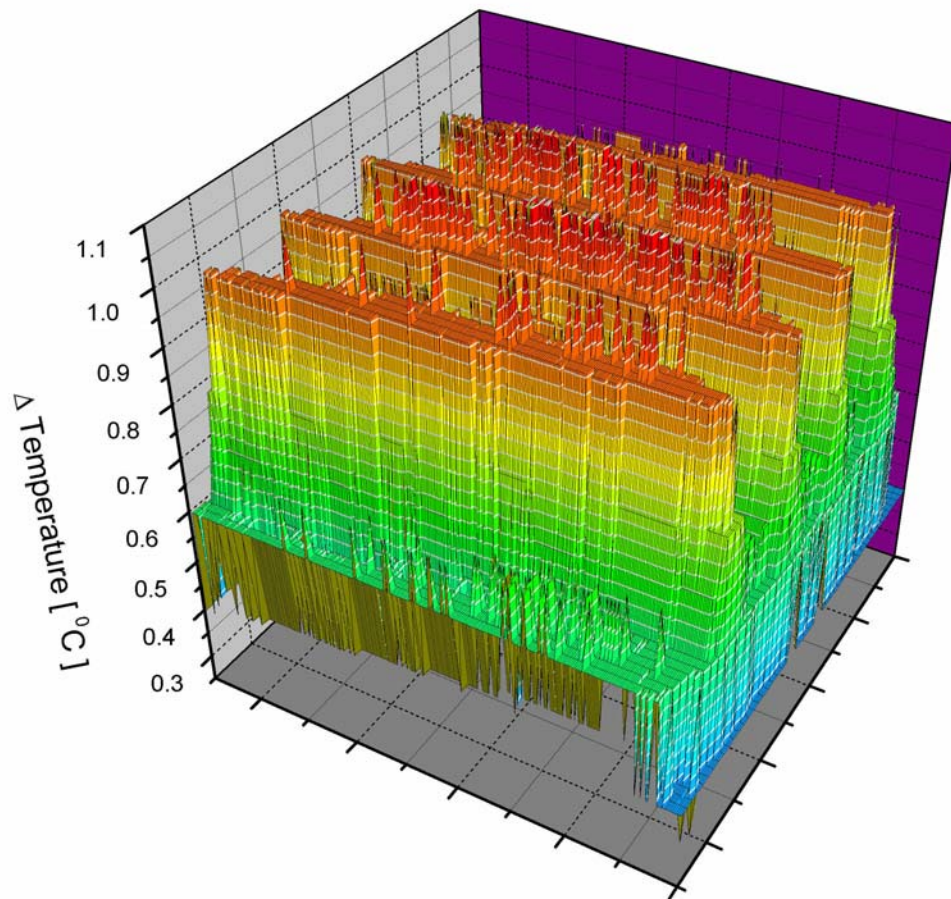
Infrared Profile of 4-bar LDA at 25 micron spatial resolution, 0.1 C temperature resolution



Near field emission of same LDA



Facet Heating of LDA during operation



Infrared image illustrating the temperature gradient between the LDA when it is powered on and off. Profile is attained by subtracting the IR image of the LDA which is off from the image when the LDA on.



Summary of Present Characterization Capabilities



Electrical properties

- current (width, shape, amplitude, frequency, duty cycle)
- voltage (width, shape, amplitude, frequency, duty cycle)
- resistance
- efficiency

Optical properties

- average optical power
- average spectrum
- near field image

Other

- infrared image with 25 micron resolution
- visible image
- 200X visible facet inspection



Future Work



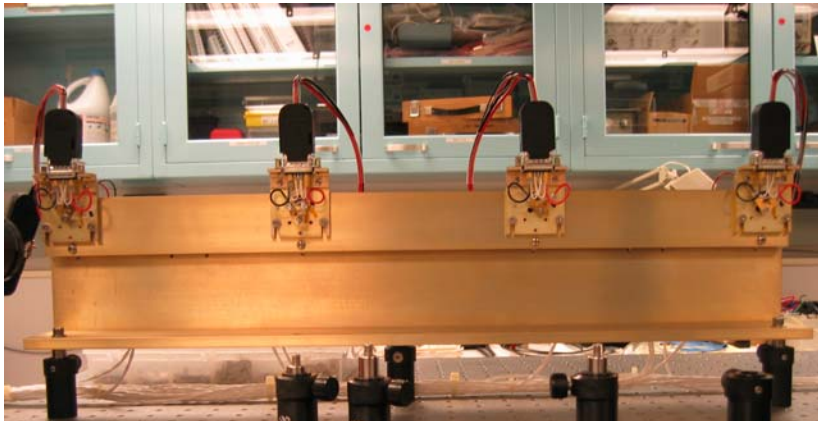
- Life tests
 - Power/temperature cycling
 - Test of different array sizes
 - Vacuum

- Radiation Tests (in collaboration with the Applied Physics Lab)

- Improved Characterization Measurements



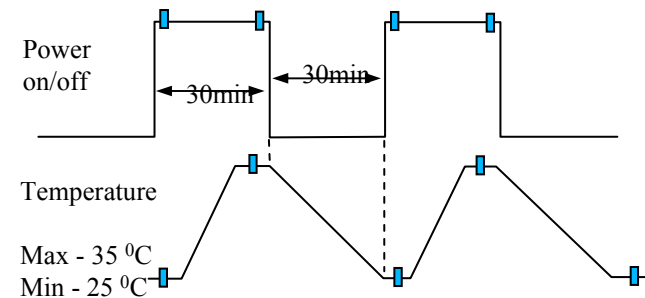
LDA Life Test



Total 12 diode will be tested

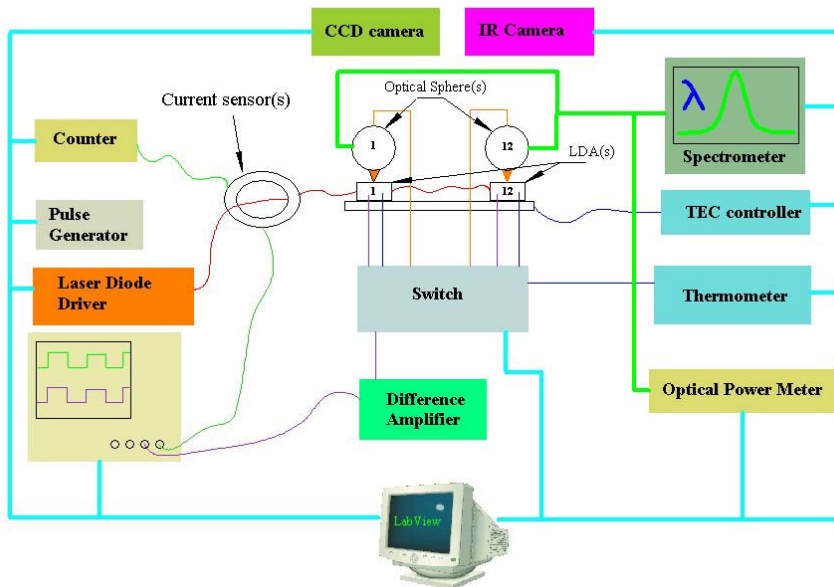
- Constant temperature (25 °C) and constant power 2-G2 and 2-G4
- Constant temperature and power ON/OFF cycling 2- G4
- Constant power and temperature cycling (25-35 °C) 2- G4
- Power ON/OFF cycling and temperature cycling 2-G2 and 2-G4

CYCLING PATTERN



■ - measurements (current, voltage, optical power, pulse counts)

- Infrared, near field images, and spectra will be taken weekly





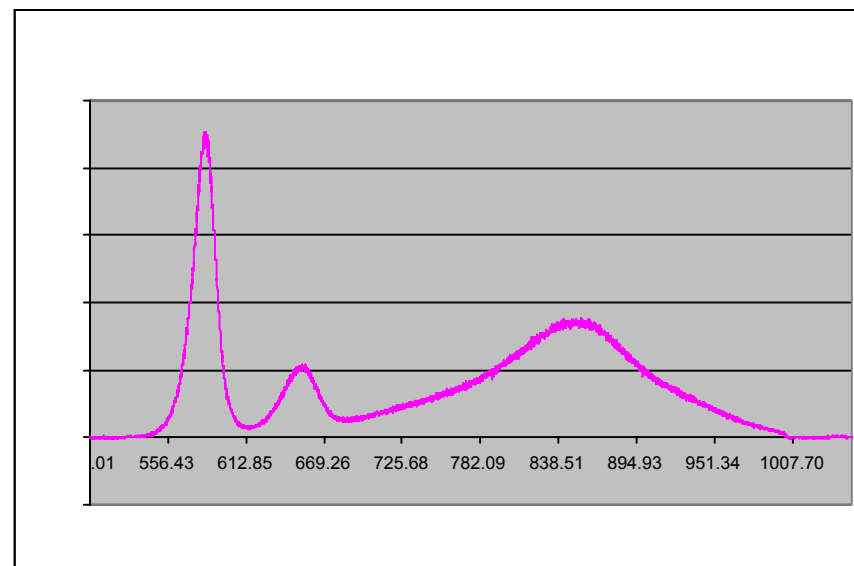
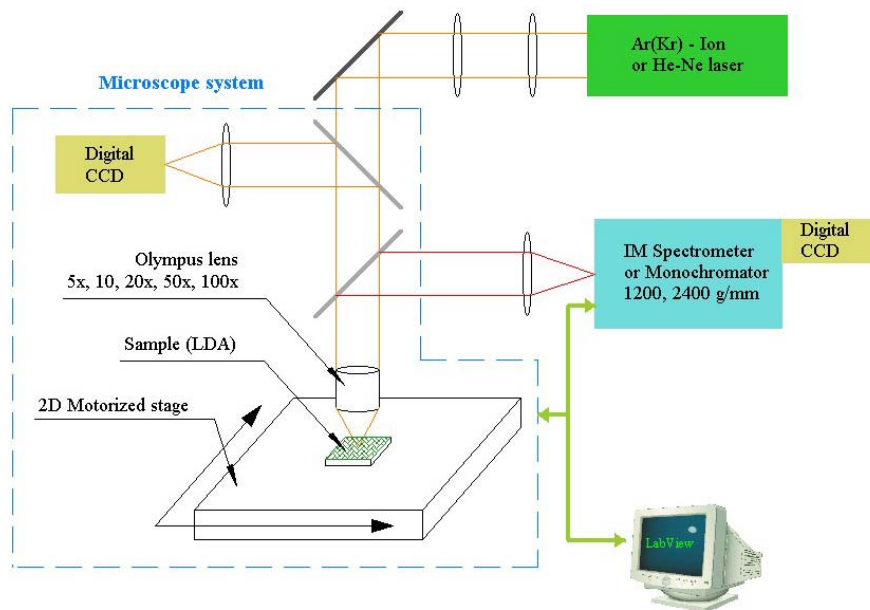
Planned LDA Characterization Improvements

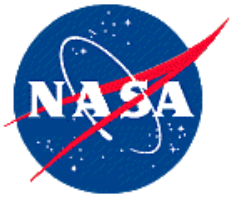


- Space resolved spectrum
- Space resolved optical power
- Time resolved spectrum
- Time resolved IR image
- Micro-photoluminescence spectroscopy



Micro Photoluminescence Spectroscopy





Conclusions



- Completed a good foundation for analysis of LDAs
- Continue to improve measurement capability
- Life tests begin soon
- Work has been focused on QCW 808 nm LDAs, the equipment could be used for other devices